Progress of the Soviet Union and Ukrainian scouting-research and fishing activities on the Kerguelen Plateau: impact and consequences

by

Leonid PSHENICHNOV (1)

ABSTRACT. - The first Soviet fishing research began in 1967 on the Kerguelen Plateau. This research expansion in the Indian sector of the Southern Ocean is associated with achievements in whaling and the discovery of many large fishes and squids in the stomachs of toothed whales. This suggested that the area supported high bioproductivity and possible substantial fish stocks. In 1970 and 1971, more than 3 000 t and 200 000 t respectively, were caught, where more than 70% of catch are Marbled notothenia (*Notothenia rossii*). Thirty large-capacity trawlers operated in the area at that time. In 1974, fishing was based on Mackerel icefish (*Champsocephalus gunnari*). In 1977, fishing expanded on some rises and banks around the main Kerguelen shelf. This expansion was because of scouting-research vessels taking part in fishing expedition. In 1984, aggregations of Patagonian toothfish (*Dissostichus eleginoides*) were found and fished with bottom trawls. Data systematization in the 1970s permitted regular (annual) stock assessments for the main target species and to plan fishing expeditions for the next seasons. The definition of some of the main criteria of the ecosystem approach to the exploitation of Antarctic marine living resources was established on fishing knowledge (including the Marbled notothenia overfishing period) in the Kerguelen plateau.

RÉSUMÉ. - Déroulement des activités de prospection pour la recherche et la pêche de l'Union soviétique et de l'Ukraine sur le Plateau de Kerguelen : impact et conséquences.

L'Union soviétique réalisa sa première campagne de recherche axée sur les pêcheries sur le Plateau de Kerguelen en 1967. Cette extension dans le secteur indien de l'océan Austral est associée avec la fin de la chasse à la baleine et la découverte de nombreux et grands spécimens de poissons et calmars dans les estomacs des baleines à dents. Cette découverte indiquait que la zone était source d'une bioproductivité élevée et pouvait éventuellement recéler d'importants stocks de poissons. Respectivement plus de 3 000 et 200 000 tonnes de poissons furent capturés en 1970 et 1971 dont plus de 70% concernait le colin de Kerguelen (*Notothenia rossii*). Une trentaine de chalutiers de forte capacité opéraient alors sur zone. En 1974, la pêcherie ciblait le poisson des glaces (*Champsocephalus gunnari*). La pêcherie s'étendit en 1977 sur les rides sous-marines et les bancs présents autour du Plateau principal de Kerguelen, Cette extension fut le résultat des campagnes de prospection de navires de recherche du poisson qui prenaient part aux expéditions de pêche. Les concentrations de légine australe (*Dissostichus eleginoides*) furent trouvées en 1984 et pêchées au moyen de chaluts de fond. L'acquisition systématique des données dans les années 1970 permit des évaluations régulières (annuelles) des stocks pour les principales espèces ciblées et servit à planifier l'organisation de la pêcherie pour les années suivantes. Enfin la définition de quelques uns des critères principaux utiles pour l'approche écosystémique de l'exploitation des ressources marines vivantes de l'océan Austral fut acquise à partir des connaissances issues des pêcheries (incluant la période de surexploitation du colin de Kerguelen) du Plateau de Kerguelen.

Key words. - Kerguelen - Heard - Scouting-research - Fishing - *Notothenia rossii* - *Champsocephalus gunnari* - *Dissostichus eleginoides*.

All Soviet and Ukrainian fishing activity on Kerguelen Plateau can be classified based on two fishing areas: the shelf of the Kerguelen Islands and the shelf of Heard Island.

The shelf of the Kerguelen Islands (northern part of the Kerguelen Plateau)

In the 1970s and 80s, the shelf of the Kerguelen Islands was one of few areas with a real and stable fishery for the USSR fishing fleet in the Indian sector of Southern Ocean.

For the first time in 1967, a fishing vessel from the port of Kerch, with biologists and marine scientists onboard, started expeditions in the Indian sector of the Southern Ocean, which have only been explored before by whalers. The stimulus of the first scouting expeditions and the subsequent ones resulted in the intensive research operations by the Soviet and other biologists in the Antarctic Region. This coincided with the International Geophysical Year (1957-1958), and the discovery of substantial quantities of large fish and squids in stomachs of toothed whales, suggesting high biological productivity in the area and the possibility of significant fishery resources.

In 1967, the vessel *Aelita* (Fig. 1) discovered for the first time the presence of notothenioid fishes on the shelf of the Kerguelen and Crozet Islands, and in 1968, aggregates of

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(1) Laboratory of Southern Ocean Bioresource, Southern Scientific Research Institute of Marine Fisheries and Oceanography (YugNIRO), 2 Sverdlov str., Kerch 98300, Crimea, Ukraine. [lkpbikentnet@rambler.ru]

Figure 1. - Fishing research vessel *Aelita*.

Lepidonotothen squamifrons (Günther, 1880) and *Notothenia rossii* Richardson 1844 were found in Kerguelen Islands.

In 1969, a scientific-scouting vessel *Skif* (Fig. 2) came to the shelf for the first time. It carried out fishery operations on *L. squamifrons* on the south-eastern ground of the shelf. In the same year, the large-capacity fishing vessel *Van Gogh* focused on target fishery, and in the 1970 fishing season more than 3 000 t of fish were caught. In the first half of 1970, in the northern part of the shelf, *Skif* discovered feeding aggregations of *N. rossii*, and in June discovered spawning aggregations to the south-east of the Kerguelen Island. In 1971, 30 large-capacity vessels were operating in the area, catching more than 200 000 t, of which more than 70% was *N. rossii*. The high fishing pressure and enormous fishing effort (large number of vessels concentrating on a relatively small known spawning and feeding grounds of *N. rossii*) ended the fishery just after it started. In 1972, the Marbled notothenia fishery was over.

By 1973, scouting research vessels from Kerch had given enough reliable scientific description of the area around the Kerguelen Islands. Detailed bathymetric, geological and meteorological charts were prepared; currents and other oceanographic parameters of waters were measured; ichthyofauna, benthos and plankton were described. Recommendations were given to fishing vessels in search for three principal fish species: Marbled notothenia (*N. rossii*), Grey notothenia (*L. squamifrons*), and Mackerel icefish *(Champsocephalus gunnari* Lönnberg 1905). At that time, hydroacoustic devices were not yet available so basic physical parameters were used to search notothenioid fishes near the bottom or in the water column.

In 1978, France, as well as many other countries, introduced a 200-mile fishing zone in its overseas territorial waters. Unrestricted fishing and research in the fishing zone of the Kerguelen Islands stopped. After 1979, the fishery was renewed on the basis of the bilateral intergovernmental agreement which, in turn, excluded carrying out scientific research with the aim of studying and monitoring target stocks in the area in question. Scientists had to evaluate the state of fish resources from the results of fishery operations and scientific observations carried out by the Kerch Southern Scientific Research Institute of Marine Fisheries and Oceanography (YugNIRO) onboard fishing vessels.

The entire duration of Soviet and Ukrainian research, search and fishing fleet on the shelf of Kerguelen Islands can be divided into three basic stages. From 1967-1976 when the discovery of high fish resources of *N. rossii* attracted large number of fishing vessels and the consequent depletion of the stock. From 1971-1995, a change in exploratory tactics for new target species, expansion of the search area, shift in fishing strategies on the basis of scientific data obtained, and estimation of fish stocks occurred. The fishery switched to *C. gunnari* as the principal species. A decrease of research and scouting activity occurred from 1991-1999 (Ukrainian stage). This time, the fishery shifted to the highly profitable *Dissostichus eleginoides* Smitt 1898.

Since 1974, Mackerel icefish dominated the catches of the fishing fleet, and in 1977 the fishery dispersed to the banks adjoining the shelf around the Kerguelen Islands. The spatial expansion of the fishery occurred due to participation of scouting-research vessels in the fishery expeditions. In 1984, sufficiently large aggregations of Patagonian toothfish were discovered and target fishing by bottom trawls began.

Official statistical catches for Subarea 58.5.1 by the Food and Agriculture Organization (FAO) for these species has minor differences from the Soviet and Ukrainian data and

Figure 2. - Scientific-scouting vessel *Skif*.

Table I. - Catch (thousands of tons) per year by the Soviet and Ukrainian fishing fleet on the Kerguelen Plateau.

Split-year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
N. rossii	0.02	0	0.027	3.626	149.7	37.4	2.5	4.1	6.5	0.1	1.9	1.6	0	6	6	1.2	0.9
L.squamifrons	0	0	0.073	0.162	16.9	43.5	0.009	0.4	6.6	4.8	6.4	2.3	0	10.3	6.9	2.3	2.1
C.gunnari	0	0	0	0	29.900	10.200	0	11	10.7	11.9	54.2	5.7	0	0.3	4.8	24.5	12.8
D.eleginoides	0	0	0.002	0	1	1.3	0.01	0.062	0	0.1	0.4	0.1	0	0	0	0	0.1

Split-year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N. rossii	1.4	1.1	0.5	0	0.1	0.2	0.112	0.292	0	0.002	0	0	0	0	0	0
L.squamifrons	8	3.5	3.5	0.2	0.6	1.9	1.25	0.096	0.001	0.01	0	0	0	0	0	0
C.gunnari	2.5	23.1	2.7	0.1	17.7	6	0.2	13.27	0.014	0	0	9.915	3.693	0	0	0
D.eleginoides	5.5	1.7	2.4	0.8	1.4	0.4	0.55	0.378	2.044	1.869	0.664	4.957	1.592	0.65	0.501	0.473

does not always correspond with real catches. Catches per year of the target fish species by the Soviet and Ukrainian fishing fleet on the Kerguelen Plateau are shown in table I.

Systematization of data obtained in the 1970s allowed not only the regular assessment of the primary commercial fish stocks, but also the planning of expeditionary activities of the fishing fleet. The results of scientific investigation and assessment of fish biomass allowed the elaboration of a fishing calendar for the commercial fleet with estimates of probable catch per month in the next two or three years.

The results of research and scientific observations showed that the change of *C. gunnari* abundance on the shelf of Kerguelen Islands was observed with periodicity of three years, and indicated that this is the reason for significant inter-annual fluctuations of the total biomass of fish and invertebrates (scavengers) in that area. According to YugNIRO scientists, in the years of highly abundant age classes entering the fishery, the biomass of all the target fish species on the shelf reached the maximal values of 250-280 000 t, and the minimal biomass estimates were at 70-90 000 t. It should be noted that the biomass of the basic fish species in this area (including *N. rossii* which, in the opinion of our scientists, is most likely close to virgin biomass) have changed insignificantly in the last years. The complexity of biomass assessment for certain fish species on the shelf of the Kerguelen Islands is explained by the high degree of variability of the spatial distribution of those species within the limits of the shelf and adjoining seamounts (for example, the discovery of the *C. gunnari* adult aggregation in the pelagic zone when the fishing fleet traditionally operated with bottom trawls). Intensive operations by the Soviet research and scouting fleet on the shelf of the island in the 1970s allowed further understanding of the main principles of biology, ecology and fishery ethology of the target fish species over a short period of time.

Fishery activities (including participation of the fishing fleet in over-fishing of Marbled notothenia) in area of the Kerguelen Islands established and brought into action some of the basic criteria of the ecosystem approach to the exploitation of living resources both in the Southern Ocean, and in the whole World Ocean.

The shelf of the Heard Island (the southern part of the Kerguelen Plateau)

Scouting operations in this region were carried out from 1971-1978 and in 1987. From 1971-1978, four research-scouting trips were done on the shelf of the Heard Island, within the limits of the current economic zone of Australia.

During those years, fishing vessels occasionally entered the area, but no sufficient stable aggregations of commercial fish species were detected. At the same time, there was a good fishery base nearby (the shelf of the Kerguelen Islands) which constantly attracted fishing vessels. The first time the fishing vessels commenced fishery in the southern part of the Kerguelen Plateau was in 1974. Highest catches were obtained from 1976-1978 when five to six vessels caught more than 10 000 t of fish annually (about 70% of the catch is *C. gunnari*).

In 1987, detailed research operations were carried out to locate and assess the stocks of discovered fish aggregations, i.e., detailed geological, oceanographic and plankton complex surveys, as well as trawling surveys and transects within the limits of prospective fishery aggregations.

Except for the main shelf area of the Kerguelen Plateau, within the economic zone of Australia, the seamount raisings and banks Yuzhnaya (= Southern), Srednyaya (= Middle), Shchuchya (= Pike) and Vostochnaya (= Eastern) were surveyed. Bank Novaya (= New) was marked out, representing an extended underwater ridge to the east of the plateau. Bank Zapadnaya (= Western) which has been surveyed earlier, and where fishery operations were carried out in the 1970s, was almost completely in the French zone. During the trip, substantial bathymetric operations on all the banks mentioned were executed, as well as on the shallow plateau in the areas of the main *C. gunnari* aggregations. To the north of the Heard Island, low oxygen content and high hydrogen sulphide content was found near the bottom, where there is large amount of detritus and relatively high benthos biomass. Most likely, it was one of the places where current circulation patterns favoured sedimentation on a bottom of huge masses of plankton which remained there as organic deposits.

Although in the 1970s, fish aggregations were found and harvested by fishing vessels on banks Novaya, Shchuchya and Vostochnaya. In 1987, the aggregations of the species on those banks were absolutely absent. The main core of *C. gunnari* aggregations appeared in the southern part of the plateau, and it coincided with the cyclonic circulation of water masses. Increased biomass of plankton was noted which was revealed with the help of surveys by plankton nets. *Champsocephalus gunnari* aggregations were formed both in the pelagic zone (in the layer of 80-170 m above seafloor depths of 210-240 m) and in the near-bottom layer. The aggregations consisted of three size-age groups that were synchronized with the main aggregation of the same species in the waters to the north-east of the Kerguelen Islands. Some distinctions between the two basic populations of *C. gunnari* at Kerguelen-Heard plateau were recorded, leading to the conclusion that similar independent, probably semi-isolated populations of the species exist in this area.

In 1987, the core of the aggregation covered an area greater than 170 km^2. The total stock in the investigated aggregation alone was more than 24 000 t. Total allowable catch from this aggregation could reach 6 000 t. Furthermore, operations with accompanying echosounder detected one more aggregations on the other ground of the shelf within the economic zone of Australia, although its parameters were not surveyed.

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